

WHAT IS CLAIMED IS:

1. An RF-actuated microelectromechanical systems (MEMS) switch module,
comprising:
- 5 a) an antenna for receiving an externally-generated RF control signal, and
providing an antenna output signal representative thereof;
- b) receiver means operatively connected to said antenna for receiving said
antenna output signal and generating a DC voltage representative thereof; and
- 10 c) a MEMS switch element having a control voltage port connected to said
receiver means and at least two switching ports operable upon application of
said DC voltage to said control voltage port;

15 whereby said at least two switching ports of said MEMS switches are
actuated when said externally-generated RF control signal is received at said
antenna.

2. The RF-actuated MEMS switch module, as recited in claim 1, wherein said
receiver means comprises:
- 20 i) a tuned circuit operatively connected to said antenna and having an input
port for receiving said antenna output signal, wherein said tuned circuit and
said antenna form a circuit substantially resonant at said RF control signal,
said tuned circuit providing a tuned circuit output signal; and
- 25 ii) detector means operatively connected to said tuned circuit to receive said
tuned circuit output signal and to generate a DC voltage representative
thereof.

3. The RF-actuated MEMS switch module, as recited in claim 2, wherein said tuned circuit is tuned to a frequency related to said externally-generated RF control signal.

5 4. The RF-actuated MEMS switch module, as recited in claim 1, wherein said MEMS switch element is bi-stable, whereby said at least two switching ports are alternately connectable to and disconnected from one another upon application of said externally-generated RF control signal.

10 5. The RF-actuated MEMS switch module, as recited in claim 1, further comprising:
d) a capacitor operatively connected between said control voltage port and a fixed reference voltage.

15 6. The RF-actuated MEMS switch module, as recited in claim 5, wherein said fixed reference voltage is ground potential.

20 7. The RF-actuated MEMS switch module, as recited in claim 2, further comprising:
e) encapsulating material substantially completely surrounding said antenna, said tuned circuit, said detector, and said MEMS switch element, said at least two switching ports being presented outside said encapsulating material.

8. The RF-actuated MEMS switch module, as recited in claim 7, wherein said encapsulating material is opaque.

25 9. The RF-actuated MEMS switch module, as recited in claim 4, wherein said MEMS module is connected to an active microwave antenna element.

30 10. The RF-actuated MEMS switch module, as recited in claim 4, wherein said MEMS module is connected to a passive microwave antenna element.

11. The RF-actuated MEMS switch module, as recited in claim 7, wherein said MEMS module forms part of a multi-layer printed circuit structure.

12. The RF-actuated MEMS switch module, as recited in claim 1, wherein said externally-generated RF control signal comprises an RF signal having a wavelength of approximately one millimeter.

13. An RF-actuated microelectromechanical systems (MEMS) switch module, comprising:

a) a MEMS switch element having at least two switching ports alternately connectable one to the other upon application of a control voltage at a control voltage port of said MEMS switch;

b) an antenna for receiving an externally-generated RF control signal having a predetermined frequency, and providing an antenna output signal representative thereof, said antenna being tuned to said predetermined frequency;

c) a tuned circuit operatively connected to said antenna and having an input port for receiving said antenna output signal and, in cooperation with said antenna, providing a circuit substantially resonant at a frequency related to said predetermined frequency of said RF control signal, said tuned circuit providing a tuned circuit output signal; and

d) detector means operatively connected to said tuned circuit for receiving said tuned circuit output signal and generating a DC voltage representative thereof, said detector means also being operatively connected to said control voltage port of said MEMS switch;

whereby said two switching ports of said MEMS switch are alternately connected to and disconnected from one another when said externally-generated RF control signal is received at said antenna.

5 14. The RF-actuated MEMS switch module, as recited in claim 13, further comprising:
 e) a capacitor operatively connected between said control voltage port and a fixed
 reference voltage.

10 15. The RF-actuated MEMS switch module, as recited in claim 14, wherein said fixed
 reference voltage is ground potential.

15 16. The RF-actuated MEMS switch module, as recited in claim 13, further comprising:
 e) encapsulating material substantially completely surrounding said antenna, said
 tuned circuit, said detector, and said MEMS switch element, said at least two
 switching ports being presented outside said encapsulating material.

17. The RF-actuated MEMS switch module, as recited in claim 16, wherein said
 MEMS switch module is included within a multi-layer printed circuit structure.

20 18. A selectively changeable radio frequency (RF) element, comprising: at least two
 RF sub-elements electrically connectable to one another by an RF-actuated MEMS
 switch, said RF-actuated MEMS switch receiving an RF control signal at a
 predetermined frequency and, in response thereto, selectively connecting said at
 least two sub-elements.

25 19. The selectively changeable RF element as recited in claim 18, wherein said RF
 element forms part of at least one antenna structure from the group: antenna
 element, antenna segment, frequency-selective surface (FSS), artificial dielectric,
 and frequency-selective volume (FSV).

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20. The selectively changeable RF element as recited in claim 19, wherein said RF-actuated MEMS switch comprises at least two RF-actuated MEMS devices adapted to respond to RF actuating signals at least two different frequencies.

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